

STUDY GUIDE

IRON AND MANGANESE REMOVAL

SUBCLASS I

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
BUREAU OF INTEGRATED SCIENCE SERVICES
P. O. BOX 7921
MADISON, WI 53707

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PREFACE

This operator's study guide represents the results of an ambitious program. Operators of wastewater and water supply facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for this subgrade.

The objectives in this study guide have been organized into modules, and within each module they are grouped by major concepts.

HOW TO USE THESE OBJECTIVES WITH REFERENCES

In preparation for the exams, you should:

1. Read all the objectives that apply to the grade level desired and write down the answers to the objectives that readily come to mind.
2. Use the references at the end of the study guide to look-up answers you don't know. This one set of references covers all of the objectives.
3. Write down the answers found in the references to those objectives you could not answer from memory.
4. Review all answered objectives until you can answer each from memory.

IT IS ADVISABLE THAT YOU ATTEND SOME FORM OF FORMAL TRAINING IN THIS PROCESS BEFORE ATTEMPTING THE CERTIFICATION EXAM.

Choosing A Test Date

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates can be found in the annual DNR "Certified Operator," or by contacting your DNR District operator certification coordinator.

IRON AND MANGANESE REMOVAL

MODULE A: PRINCIPLE, STRUCTURE AND FUNCTION

CONCEPT: PRINCIPLE OF IRON & MANGANESE REMOVAL

1. Identify the characteristics of an atom, an element, and a compound.
2. Define an ion, anion, and a cation.
3. Explain where iron and manganese are found, and how they get into water.
4. Discuss problems associated with water containing high concentrations of iron and manganese.
5. Describe different methods used to control iron and manganese problems.
6. Define coagulation, flocculation and sedimentation.
7. Identify concentrations at which iron and manganese begin to pose problems.
8. Compare primary versus secondary contaminate levels.
9. Define oxidation reaction as related to iron and manganese.
10. Differentiate between ferrous and ferric iron, and bivalent and quadrivalent manganese.

CONCEPT: STRUCTURE AND FUNCTION

11. Discuss the common types of Iron Removal systems that utilize oxidation.
12. Discuss the methods of oxidizing iron and manganese.
13. Draw a line diagram of a pressure aeration filtration system for iron and manganese removal.
14. Draw a line diagram of an open air aeration system for iron and manganese removal.

15. Sketch a typical pressure filtration unit.

16. Define the following filtration process unit parts.

- | | |
|----------------------------|----------------------------------|
| A. Compressor | G. Loss of Head Gauges |
| B. Aerator/Aeratorator | H. Air Relief Valve |
| C. Rate of flow Controller | I. Surface Wash System |
| D. Media | J. Air Scour System |
| E. Gravel Support Bed | K. Raw & Finished Water Sampling |
| F. Underdrain System | Taps |

17. Explain the need for freeboard space in a filter.

MODULE B: OPERATION AND MAINTENANCE

CONCEPT: OPERATION

18. Explain the normal operation and backwashing of a pressure filtration unit.
19. Explain the normal operation and backwashing of a gravity filtration unit.
20. Identify different types of media used in pressure and gravity filters.
21. Discuss suitable numerical values for filter flow rates and headloss.
22. Describe the backwashing process.
23. Discuss suitable backwashing rates, and explain why backwash rates vary according to media used.
24. Explain how to determine when a filter must be backwashed.
25. Discuss the disposal of backwash wastes from a filter unit.

CONCEPT: MAINTENANCE

26. Summarize the storage of filtration units.

27. Prepare a calendar of maintenance events that should be routinely performed.

MODULE C: MONITORING AND TROUBLESHOOTING

CONCEPT: MONITORING

28. Describe iron and manganese related bacteria.
29. Discuss the laboratory tests used for process control for iron/manganese removal systems.
30. Discuss the monitoring frequency for the laboratory tests performed on iron and manganese removal systems.

CONCEPT: TROUBLESHOOTING

31. Explain the cause of mud balls, and provide a solution to the problem.
32. Explain the cause of loss of media, and provide a solution to the problem.
33. Explain the cause of channeling in the media, and provide a solution to the problem.
34. Explain the cause of air binding in a gravity filter, and provide a solution to the problem.
35. Explain the cause of increased media thickness, and provide a solution to the problem.
36. Explain the cause of increased poor iron removal, and provide a solution to the problem.
37. Explain the cause of white water, and provide a solution to the problem.
38. Explain the cause of iron/manganese bacteria in the filter media, and provide a solution to the problem.

MODULE D: SAFETY AND CALCULATIONS

CONCEPT: SAFETY

39. Describe safety problems when repair work is required at Iron/Manganese Removal plants.

CONCEPT: CALCULATIONS

40. Given data, calculate the percent removal of iron.

41. Given data, calculate the pounds of chlorine used per day.

RESOURCES

1. SMALL WATER SYSTEM OPERATION AND MAINTENANCE. 1st Edition (1990). Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.
2. STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER. 17th Edition (1989), 18th Edition (1992). Joint Publication of: American Public Health Association; American Water Works Association; and, Water Environment Federation (Old WPCF). Publication Office: American Public Health Association, 1015 Fifteenth Street NW, Washington, DC 20005.
3. WATER TREATMENT PLANT OPERATION. 2nd Edition (1989). Volumes 1 and 2. Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.
4. WISCONSIN ADMINISTRATIVE CODE NR 809 (OLD 109) SAFE DRINKING WATER. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison WI 53707.
5. WISCONSIN ADMINISTRATIVE CODE NR 811 REQUIREMENTS FOR THE OPERATION AND DESIGN OF COMMUNITY WATER SYSTEMS. Wisconsin Department of Natural Resources, Attn: Ken Cramer, P.O. Box 7921, Madison, WI 53707.

THE FOLLOWING ADDITIONAL RESOURCES CAN BE OBTAINED FROM:

AMERICAN WATER WORKS ASSOCIATION
MEMBER SERVICE DEPARTMENT
6666 W. QUINCY AVENUE
DENVER, CO 80235
(303) 794-7711

1-800-92-ORDER (FOR CHARGE CARD CUSTOMERS OR AWWA MEMBERS ONLY)

6. BASIC MANAGEMENT PRINCIPLES FOR SMALL WATER SYSTEMS. AWWA No. 20222 (1982).
7. CORROSION CONTROL FOR OPERATORS. AWWA No. 20232 (1986).
8. CROSS-CONNECTION AND BACKFLOW PREVENTION. Gustave J. Angele. AWWA No. 20106 (1974).
9. DISINFECTION BY-PRODUCTS: CURRENT PERSPECTIVES. AWWA No. 20032 (1989).

10. MAINTENANCE MANAGEMENT. James K. Jordan. AWWA No. 20252 (1990).
11. NEW DIMENSIONS IN SAFE DRINKING WATER-SECOND EDITION. AWWA No. 20235 (1988).
12. PLAIN TALK ABOUT DRINKING WATER. James M. Symons. AWWA No. 70076 (1991).
13. PUBLIC INFORMATION - HOW TO BUILD A SUCCESSFUL PUBLIC INFORMATION/PUBLIC RELATIONS PROGRAM. AWWA No. 20242 (1989).
14. SAFE DRINKING WATER ACT SERIES:
 - SURFACE WATER TREATMENT RULE. AWWA No. 70055 (1990)
 - PUBLIC NOTIFICATION. AWWA No. 70056 (1990)
 - TOTAL COLIFORM RULE. AWWA No. 70057 (1990)
 - VOC'S AND UNREGULATED CONTAMINANTS. AWWA No. 70058 (1990)
 - LEAD AND COPPER. AWWA No. 70073 (1991)
 - PHASE II: VOC'S, IOC'S, AND SOC'S. AWWA No. 70074 (1991)
15. TREATMENT TECHNIQUES FOR CONTROLLING TRIHALOMETHANE IN DRINKING WATER. AWWA, No. 20221 (1982).
16. WATER CONSERVATION. William O. Maddaus. AWWA No. 20238 (1987)
17. WATER QUALITY AND TREATMENT-FOURTH EDITION. AWWA No. 10053 (1990).